PROCEEDINGS
OF
THE ROYAL SOCIETY.

1830–1831. No. 6.

June 9, 1831.

HIS ROYAL HIGHNESS THE DUKE OF SUSSEX, K.G., President, in the Chair.

The Hon. Frederick de Roos, and Edward Coleman, Esq., were elected Fellows of the Society.

The following Presents were received, and thanks ordered for them:—

Transactions of the Cambridge Philosophical Society. Vol. 3, Part 3; and Vol. 4, Part 1. 4to.—*Presented by the Society.*

Zoological Society.—Report at the Anniversary Meeting, 1831.

———— Notices of Proceedings (March 8 to May 10, 1831). 8vo.—*The Society.*

Yorkshire Philosophical Society.—Annual Report for 1830. 8vo. —*The Society.*

Astronomical Observations made at the Radcliffe Observatory, Oxford; from April 30, 1830, to April 30, 1831. By Professor Rigaud, F.R.S., folio MS.—*The Radcliffe Trustees.*

Astronomical Observations made at the Observatory of Cambridge. By G. B. Airy, M.A. Vol. 3: 1830. 4to.—*Professor Airy.*

A new illustrated Road Book of the Route from London to Naples, containing Twenty-four highly finished Views. Part 1. London to Paris. By W. Brockedon, Esq. 8vo.—*The Author.*

A Volume containing various Documents, and a Lecture, relative to the Prevention of Shipwreck; and an Essay on the Extinction and Prevention of destructive Fires. By Captain G. W. Manby. 8vo.—*The Author.*

Nuovo Desideratum di Chine Vere e di Specie Affini, di V. L. Brera, M.D. 4to.—*The Author.*

The Valley of Gosau in the Salzburgh Alps; drawn from Nature, and on Stone, by Charlotte Murchison. (Two impressions.)—*Mrs. Murchison.*

A Portrait Sketch of Frederick Albert Winsor, Originator of Public Gas Lighting, and Founder of the first established Gas Light Companies in England and in France.—*F. A. Winsor, Esq.*

A paper was read, entitled "Researches in Physical Astronomy." By J. W. Lubbock, Esq., V.P. and Treasurer of the Royal Society.

The author extends, in the present paper, the equations he has already given for determining the planetary inequalities, as far as the terms depending on the squares and products of the eccentricities, to the terms depending on the cubes of the eccentricities and quantities of that order, which he does by means of a table, similar to the one given in his lunar theory; and applies them particularly to the determination of the great inequality of Jupiter, or at least such part of it as depends on the first power of the disturbing force. That part which depends on the square of the disturbing force may, he thinks, be most easily calculated by the methods given in his lunar theory. He recommends it as particularly convenient to designate the arguments of the planetary disturbances by indices. The bulk of the paper is occupied by the tables, and by examples demonstrating their use.

A paper was read, "On the Theory of the Elliptic Transcendents." By James Ivory, A.M., F.R.S., &c.

Fagnani discovered that the two arcs of the periphery of a given ellipse may be determined in many ways, so that their difference shall be equal to an assignable straight line; and proved that any arc of a lemniscate, like that of a circle, may be multiplied any number of times, or may be subdivided into any number of equal parts, by finite algebraic equations. What he had accomplished with respect to the arcs of the lemniscates, which are expressed by a particular elliptic integral, Euler extended to all transcendents of the same class. Landen showed that the arcs of the hyperbola may be reduced, by a proper transformation, to those of an ellipse. Lagrange furnished us with a general method for changing an elliptic function into another having a different modulus; a process which greatly facilitates the numerical calculation of this class of integrals. Legendre distributed the elliptic functions into distinct classes, and reduced them to a regular theory, developing many of their properties which were before unknown, and introducing many important additions and improvements in the theory. Mr. Abel of Christiana happily conceived the idea of expressing the amplitude of an elliptic function in terms of the function itself, which led to the discovery of many new and useful properties. Mr. Jacobi proved, by a different method, that an elliptic function may be transformed in innumerable ways into another similar function, to which it bears constantly the same proportion. But his demonstrations require long and complicated calculations; and the train of deductions he pursues does not lead naturally to the truths which are proved, nor does it present in a connected view all the conclusions which the theory embraces. The author of the present paper gives a comprehensive view of the theory in its full extent, and deduces all the connected truths from the same principle. He finds that the sines or cosines of the amplitudes, used in the transformations, are analogous to the sines or cosines of two circular arcs, one of which is a multiple of the other; so that the former quantities are changed into the latter when the modulus is supposed to vanish in the algebraic expression. Hence he is enabled to transfer to the elliptic transcendents the same methods of investigation that succeed in the circle: a procedure which renders the demonstrations considerably shorter, and which removes most of the difficulties, in consequence of the close analogy that subsists between the two cases.

A paper was read, entitled, "An Experimental Investigation of the Phenomena of Endosmose and Exosmose." By William Ritchie, Esq., M.A., F.R.S., Professor of Natural Philosophy in the Royal Institution of Great Britain.

M. Porret had, in the year 1816, announced the discovery, that if a vessel containing water be divided into two compartments by a diaphragm of bladder, and placed in the voltaic circuit, the water would rise on the negative side above its level in the positive compartment. M. Dutrochet discovered, that if alcohol be placed in one of the chambers, and water in the other, without employing the voltaic battery, the water will percolate through the bladder, and the fluid will rise in the chamber containing the alcohol: an action to which he gave the names of *Endosmose* and *Exosmose*, according to its direction with regard to the side of the membrane considered; comparing its two sides to those of a Leyden jar in opposite electrical states. This electrical theory has been combated by M. Poisson: but the true explanation of this singular phenomenon does not appear to have been yet given.

The experiments of the author, of which an account is given in this paper, were made with a glass tube, about an inch in diameter, one end being drawn out into a slender tube of the interior diameter of one eighth of an inch, and having a piece of bladder tied over the other end. When this *Endosmometer*, as it has been called, is by means of a small funnel introduced into the narrow end filled with alcohol, and immersed in water, the water penetrates through the bladder, and the spirit rises rapidly in the narrow stem. The author found on trial that this action was apparently not affected by a powerful current of voltaic electricity passed through the bladder, by introducing positive and negative wires on both sides of it. On substituting a strong solution of sulphate of zinc for the alcohol, the same negative result was obtained.

The author considers the action of the animal membrane to be the consequence of its strong attraction for water, an attraction to which it owes its hygrometric properties; while, on the other hand, the membrane has no attraction for alcohol, which has itself a powerful attraction for water. The water, therefore, finds its way easily through the membrane, and uniting with the alcohol, is carried off by it, and diffused through the liquid, making room for the other portions that successively come over. Whalebone and quills have similar hygrometric properties, and may be substituted for membranes with the same effect. All substances readily soluble in water give rise to the phenomena of endosmose, on the same principle as alcohol, such as gum, sugar, and salts. The phenomenon bears a striking resemblance to the rise of the sap in the capillary vessels of plants, both being probably dependent on the same principle; the filamentous texture of the roots performing the function of the membrane, and the contained sap that of the attractive fluid; by the agency of which that external moisture of the earth is imbibed and raised into the interior of the plant.

June 16.

JOHN W. LUBBOCK, Esq., V.P. and Treasurer,
succeeded by
HIS ROYAL HIGHNESS THE DUKE OF SUSSEX, K.G.,
President, in the Chair.

Griffith Davis, Esq. was elected a Fellow of the Society.

The following Presents were received, and thanks ordered for them:—

Trigonometrical Survey of Great Britain and Ireland.—Sheets 41 and 54 (Parts of Carmarthenshire, Worcestershire, and Warwickshire). 5 *Maps.—Presented by the Hon. Board of Ordnance.*

Proceedings of the Geological Society. No. 21. 8vo.—*The Society.*

A Treatise on Algebra. By the Rev. George Peacock, M.A., F.R.S. 8vo.—*The Author.*

On the Health of the Royal Navy, at the End of the 18th and Beginning of the 19th Century: with Practical Illustrations. By Sir Gilbert Blane, Bt. F.R.S. 8vo.—*The Author*

Reflections on the present Crisis of Public Affairs; with an Enquiry into the Causes and Remedies of the existing Clamours, and alledged Grievances of the Country. By Sir Gilbert Blane, Bt. F.R.S. 8vo.—*The Author.*

Catalogue of Oriental Manuscripts purchased at Aleppo, Damascus, Cairo, and Constantinople, by the assistance and recommendation of the late Mr. J. L. Burckhardt. 4to.—*John Lee, LL.D., F.R.S.*

Synopsis Reptilium; or Short Descriptions of the Species of Reptiles. By John E. Gray, Esq. 8vo.—*The Author.*

An engraved Portrait of John Taylor, Esq. F.R.S. Engraved by Turner from the Painting by Sir Thomas Lawrence.—*Mrs. Taylor.*

A Lithographic Portrait of Major-Gen. Hardwicke, F.R.S. From the Painting by Lucas.—*John E. Gray, Esq.*

Mémoire sur la Propagation du Mouvement dans les Milieux Élastiques. Par M. Poisson. 4to.—*Baron Poisson, For. Memb. R.S.*

Mémoire sur le Mouvement de deux Fluides Élastiques superposés. Par M. Poisson. 4to.—*The Author.*

Åminnelse-Tal öfrer Kongl. Vetenskaps-Academiens Framlidne Ledamot, Herr Adolf Murray, M D. Af dess Ledamot Erik Gadelius, M.D. 8vo.—*The Author.*

Tal om Sveriges naturförhållnden och om den inflytelse de äga på dess näringar och slöjder. Al Carl Arosenius. 8vo.—*The Author.*

A paper was read, "On the Tides in the Port of London." By J. W. Lubbock, Esq., V.P. and Treas. R.S.

This paper contains a discussion of observations of the tides made at the London Docks, and registered in various Tables, showing the time and height of high water, not only at different periods of the moon's age, but also for the different months of the year, for every minute of the moon's parallax, and for every three degrees of her declination. The tables themselves were registered by Mr. Dessiou of the Admiralty: but the arrangement of the tables and the methods employed are due to the author. The tides in the river Thames are extremely regular; and as the rise is considerable, the observations on them are easily made. Those at the London Docks present an uninterrupted series from the opening of the Docks in 1804 to the present time: which is more extensive than any extant, with the exception only of that made at Brest by order of the French Government. Some observations are also given of the tides made during one year at the East India Docks, under the superintendence of Captain Eastfield, and which were undertaken at the suggestion of the author, and made with extreme care.

The author gives an account of the mode by which the several tables were constructed; and enters at length into the various mathematical considerations which the subject involves.

The author was enabled, by the kindness of the Chairman and Directors of the London Dock Company, to present to the Society the books containing the complete series of original observations on the tides referred to in this paper.

A paper was read, "On the Friction of Fluids." By George Rennie, Esq, V.P.R.S.

The object of the author in this paper is to trace the relation subsisting between the different quantities of water discharged by orifices and tubes, and the retardations arising from the friction of the fluid. The results of the experiments hitherto made with a view of ascertaining the effects of the friction attending the mutual motion of solids and fluids, are exceedingly discordant, and therefore undeserving of confidence. Whether, for example, the retardation from friction be proportional to the surfaces, or to the velocities, are points by no means satisfactorily determined.

The experiments of the author were designed to measure the retardations experienced by solids moving in fluids at rest; and of fluids moving over solids. For this purpose, he employed a cylinder of wood, about eleven inches in diameter and two feet in length, traversed by an iron axle, upon the upper part of which a small pulley was fixed. A fine flexible silken cord was wound round the pulley, at one end, and had a weight attached to the other end. A frame was provided, allowing the apparatus to slide up and down; and the cylinder to be immersed at various depths into the river Thames. When the velocities were small, the retardation was found to be nearly as the surface: but with great velocities it appears to have but little relation to the extent of the surface immersed. The resistances of iron discs and wooden globes revolving in water were found to be as the squares of the velocities.

From the experiments made on the quantities of water discharged by orifices of different shapes and sizes from vessels kept constantly full, the author concludes, that they are in the ratio of the areas of the orifices, independently of their shape; and nearly as the square roots of the heights. In pipes bent at various angles the retardation occasioned by the flexure was not in proportion to their number.

A paper was read, " On the Sources and Nature of the Powers on which the Circulation of the Blood depends." By A. P. W. Philip, M.D. F.R.S. L. & Ed.

In the first part of this paper the author discusses the opinions which ascribe the powers that maintain the circulation in the veins to the elasticity of the heart, the resilience of the lungs, and the dilatation of the thoracic cavity in the act of inspiration. He shows experimentally that the circulation continues unimpaired when all those causes have ceased to operate; and that the very structure of the veins, the coats of which are so pliable as to collapse by their own weight, when empty, renders it impossible that the motion of the blood could be maintained in them by any cause corresponding to a power of suction in the heart.

The latter part of the paper is occupied by an inquiry into the sources and nature of the powers which really support the circulation of the blood. The capillaries, he observes, maintain the motion of their blood long after the heart has ceased to beat; this motion not being immediately affected even by the entire removal of the heart; but being accelerated, retarded, or arrested, according as the action of the capillaries is increased, impaired, or destroyed, by agents of which the operation is wholly confined to the vessels themselves. As the destruction of the heart does not immediately influence the motion of the blood in the capillaries, so the action of this organ, when in full vigour, can produce no motion of the blood in the capillaries, when these vessels are themselves deprived of power. Experiments are related with the view of proving that the arteries and veins, and more particularly the latter, are also capable of carrying on the blood they contain, even in opposition to the force of gravitation, with the greatest ease, and without the aid of any extraneous power. With regard to the nature of the power exerted by the blood-vessels, the author shows that the capillaries are as readily influenced by stimulants and by sedatives, as the heart itself; and that the arteries and veins may also be made to obey the action of stimulants; and further, that the power of the vessels bears the same relation to the nervous system as that of the heart, which is peculiar, and very different from the relation subsisting between that system and the muscles of voluntary motion. From the whole of the facts and experiments stated in this paper, the author deduces the conclusions, that the circulation is maintained by the combined power of the heart and blood-vessels, and that the power of both is a muscular power.

A paper was read, entitled, " A critical and experimental Inquiry into the Relations subsisting between Nerve and Muscle." By

Wm. Charles Henry, M.D., Physician to the Manchester Royal Infirmary. Communicated by Wm. Henry, M.D., F.R.S.

It has long been a subject of controversy among physiologists whether muscular contraction is the immediate consequence of the action of a stimulus on the muscular fibre, or whether it is necessarily dependent on a change taking place in the nerve distributed to the muscle, and excited by the stimulus. This question, the author observes, is one which, from its very nature, is incapable of a direct solution, because the intimate connection of nervous fibres with every part of the muscles renders it impossible to distinguish on which of these classes of textures the impression of the stimulus is primarily made. The continuance of the motions of the heart after the destruction of the brain and spinal cord, and even after the entire removal of the heart from the body, has been adduced as an argument of the independence of the contractile property of the muscular fibre: but this argument the author considers as inconclusive, because the nervous fibres remaining in the heart, and expanded on the interior of its cavities, may still be capable of performing their usual functions, and act as the medium of excitation to the muscular fibres: an hypothesis strongly supported by the analogy of the voluntary muscles, which, though usually excited to action by changes taking place in the central portions of the nervous system, may yet, when removed from this influence, be made to contract by irritations applied to the trunks of the nerves that supply them.

As narcotic poisons act exclusively upon the nervous system, the author conceived that they might afford the means of eliminating the action of the nerves, and thus enable us to discover what share they contribute towards muscular contraction. On applying the empyreumatic oil of tobacco, or the hydrocyanic acid, to the sciatic nerves of a rabbit, he found that the functions of that part of the nerve which was in contact with the poison was destroyed, and that irritations applied to that part no longer excited contractions in the muscles. But when the portion which had been so affected was cut off, and the galvanic wire applied to that extremity of the nerves which remained attached to the muscle, contractions were produced. Similar results were obtained when the poison was applied directly to the brain. When, on the other hand, the poison was applied to mucous surfaces so as rapidly to extinguish life, the muscles throughout the whole body were paralysed and lost all capability of being excited to contraction.

The inefficacy of opium applied to the cardiac nerves in arresting the motions of the heart has often been alleged as a proof that those motions are independent of the nerves. But the author found on trial that a solution of opium injected into the cavities of the heart, or introduced into the intestine, immediately arrested the muscular actions of these organs.

These phenomena appear to the author to accord best with the hypothesis that the immediate antecedent of the contractions of the muscular fibre is a change in the ultimate nervous filament distributed to that fibre.

A paper was read, entitled, "Experiments on the Length of the Seconds' Pendulum; made at the Royal Observatory at Greenwich." By Captain Edward Sabine, of the Royal Regiment of Artillery, F.R S.

The experiments described in this paper were made with the original convertible pendulum constructed by Capt. Kater, and employed by the author in Portland Place, in the year 1817; except that the tail pieces were removed, and the moveable weight dispensed with: and they were made on the vacuum apparatus established in the south-west angle of the Pendulum-room, the place assigned for it by the Astronomer Royal. Having had reason to suspect that the retardation of the vibrations of the pendulum performed in circular arcs, when the weight was above, was greater than that assigned by the formula commonly employed, the author first investigates the correction necessary to be applied from this cause. He next ascertains the reduction to a vacuum for the small residue of air which the apparatus still contained, or for the small portion which may have introduced itself by leakage. The alteration of rate for each degree of Fahrenheit is then determined to be 0.441, a quantity almost exactly the same as that which was deduced from a former inquiry. The result of the present inquiry is, that the vibrations of Captain Kater's pendulum, which at 57° were found to be 86069.1, are at 62°, 86066.9. At this latter temperature, the length of the seconds pendulum, in vacuo, would be 39.13734 inches. Tabular details of the experiments accompany the paper.

A paper was read, "On recrossed Vision; being the Description of a distinct Tribe of ocular Phenomena, supplementary to a Rationale of the Laws of cerebral Vision, recently published." By John Fearn, Esq. Communicated by Captain John Grover, F.R.S.

The phenomena described in this paper, and which the author designates those of *recrossed vision,* are cases in which objects placed between and very near the eye, such as the two sides of the nose, appear on opposite sides of the sphere of vision: the object on the right side of the nose being seen to the left by the right eye, and that which is on the left of the nose being seen to the right by the left eye. These and other phenomena illustrative of the well-known law by which we estimate the position of objects with relation to the eye to be in a line drawn from its image in the retina through the centre of the eye, are considered by the author as requiring further explanation. Not satisfied with the theory of Berkeley, that the mind is guided by the perceptions received from the sense of touch, in interpreting the signs furnished us by the sight, the author proposes to explain these phenomena by an hypothesis of his own, which he states in the following words. "Over and above the gift of two external or cranial eyes, man has been by his adorable Creator endowed with an internal cerebral organ, which performs the office of a *third eye,* by being the common recipient of impressions propagated either from one, or both of the external eyes; and the mind, in her chamber of percipience, steers with regard to external objects by the same principle on which the mariner steers by his compass. Thus the two cranial eyes are analogous, in principle and situation, to two magnetic compasses placed upon a ship's deck; while the third, or cerebral eye, corresponds to another compass placed in the cabin below; and the mind, situated like the captain-mariner in his cabin, knows, from consulting the cerebral eye, on what point of direction the body is steering; although the mind no more perceives either any external object, nor yet any image in the cranial eye, than the mariner perceives (even in the vulgar sense of the word perceiving) the far-off land, or haven, towards which he is surely making his way."

A paper was read, "On the Thermostat or Heat Governor, a self-acting physical Apparatus for regulating Temperature;" constructed by Andrew Ure, M.D., F.R.S.

The principle of the instrument here described is the unequal expansion of different metals by heat. A bar of zinc, alloyed with four or five per cent. of copper, and one of tin, about an inch in breadth, one quarter of an inch thick, and two feet long, is firmly and closely riveted along its face to the face of a similar bar of steel of about one third in thickness. The product of the rigidity and strength should be nearly the same, so that the texture of each may pretty equally resist the strains of flexure. Twelve such compound bars are united in pairs by a hinge joint at each of their ends; having the zinc or alloy bars fronting one another. At ordinary temperatures these bars will be parallel, and nearly in contact; but when heated, they bend outwards, receding from each other at their middle parts, like two bows tied together at their ends. When a more considerable expansion is wanted, a series of such bars is laid one over the other. The movement thus resulting is applied by the author in various ways to regulate the opening of dampers, letting in either cold air or cold water, or closing the draught of a fire-place, as the case may be. He proposes its employment to regulate the safety valves of steam boilers, as working with more certainty than the common expedients.

A paper was read, "On the Determination of the Thickness of solid Substances, not otherwise measurable, by Magnetic Deviations." By the Rev. William Scoresby, F.R.S. Lond. and Edin. Corresponding Member of the Royal Academy of Sciences of Paris, &c.

In the first part of this paper, the author states the results of a series of experiments undertaken by him with the view of ascertaining whether all bodies are equally and uniformly permeable to the magnetic influence. Out of a great number of substances not ferruginous, but of various qualities, thickness, and solidity, which were subjected to trial, no instance occurred of their offering any perceptible obstruction to the action of a magnet on a compass, when interposed between them. No interruption to this action occurred even when the intervening bodies were iron ores, of which several were tried, excepting in one or two cases in which the ore was found to be itself magnetic. Hence the author was led to conceive that an accurate estimation of the magnetic influence transmitted through solid substances, might afford an excellent mode of ascertaining the thickness of such substances which might not be otherwise determinable. In order to judge of the degree of accuracy with which this might be accomplished, he instituted various sets of experiments; first placing the magnet in a line pointing to the centre of the compass, and on a level with it, in the east and west magnetic direction; and secondly in positions more or less oblique to this direction. He found reason to conclude from these trials, that the degree of accuracy attainable by this method was such as to render it highly advantageous in mining operations. Thus the thickness of a mass of freestone rock on the Liverpool and Manchester rail-way, three feet two inches in thickness, was determined by this method to within the eighth of an inch of its actual measurement, exhibiting an error of only one 334th part of the whole.

Many experiments were made to determine the effect which the form, dimensions, quality, and number of magnets have on the extent of their directive influence on the compass. It was found that little, if any augmentation of power results from increasing the thickness of the magnet: but that, with magnets of similar form, the directive forces are nearly in the direct ratio of their lengths. The author gives the results of an extensive series of experiments on the combined influence of several magnets, arranged, either in contact or in juxta-position, in a great variety of ways. The contact of dissimilar poles was in all cases productive of an increase, and that of similar poles of a diminution of efficiency.

In the second part of this paper the author enters into an investigation of the law of the magnetic directive power with reference to distance: in which he finds it convenient to estimate all distances in multiples of the length of the magnet employed, or, more correctly, of the interval between its two poles. From the established law of magnetic force,—namely, that it is in the inverse duplicate ratio of the distance,—the author deduces formulæ for estimating the directive power of a magnet on a compass at different distances. The combined action of four magnets, on a compass of Captain Kater's construction, which was five inches in diameter, will afford a tolerably accurate measurement of the thickness of any solid intervening substance, when about forty feet thick; but even at the distance of eighty-two feet the deviation produced by the magnet will be two minutes of a degree, and therefore still very appreciable. But the sensibility of the compass to the magnetic influence might be much further increased, by the application of a small directing magnet, placed in such a situation as to neutralize the greater part of the directive influence of the earth. By this means the author obtained a deviation in the compass of about $5'$, at a distance of 61 feet, which extended through a variety of solid materials including soil, stones, and brick-work.

In the third part of this paper the author treats of the practical application of the magnetical influence in engineering, in tunneling, and in mining, for determining the thickness of solid masses in different situations where circumstances preclude the possibility of direct measurement. He adduces a variety of instances in which the information thus obtained would prove of the greatest value, in directing the operations in progress, or determining those to be undertaken, and frequently in preventing the occurrence of accidents which the want of such knowledge may occasion. He concludes with a statement and explanation of various practical directions for the employment of the method recommended.

A paper was read, "On a new Register Pyrometer for measuring the Expansion of Solids." Part II. By J. F. Daniell, Esq. F.R.S., Professor of Chemistry in King's College, London.

In this paper, which is a sequel to that published in the Philosophical Transactions for 1830, the author prosecutes the series of experiments he had commenced on the dilatation of the metals: pursuing the comparison between the results of the experiments of Dulong and Petit, with those given by his own instrument. He finds a striking accordance between them in the case of copper, as he had already done with respect to iron and platina. He gives the result of some trials which he made with a view to obtain registers of uniform composition, so as to preclude the necessity of determining the rate of expansion in each individual instance. The results of his experiments on the dilatation of the metals are given in tables; the first showing in arcs of the scales the expansions of four metals from 62° to 212°, and thence to 662° of Fahrenheit; and their respective melting points: and the second, exhibiting the expansion of certain alloys to the same points. The experiments on the melting point of cast iron give a mean of 2768°, and present a remarkable coincidence with the corrected temperature deduced from the expansion of a platina bar, plunged into melted cast iron, which was 2786°; thus affording a conclusive proof of the accuracy of the pyrometer, and of its competency to determine fixed and comparable points of very high temperature. The author accordingly thinks himself warranted in recommending the introduction of the instrument extensively in all arts and manufactures, where it is an object to regulate high temperatures, and where it is calculated to determine many questions of the highest importance both to practical and theoretical science.

Two papers were read; the one entitled, "On the Influence of Screens in arresting the Progress of Magnetic Action:" the other, "On the Power of Masses of Iron to control the attractive Force of a Magnet." By William Snow Harris, Esq. F.R.S.

The object of the first paper is to show that every substance susceptible of magnetism by induction, when interposed as a screen, tends to arrest the action of a magnet upon a third substance: this intercepting power being directly as the mass, and inversely as the susceptibility to induced magnetism. Thus, although a single plate of iron, about the sixteenth of an inch thick, effectually intercepts the action of a revolving magnet on a disc of copper, the same result is not obtained when the disc acted upon is also of iron, instead of being of copper; unless the mass of iron interposed be very considerable. The screening influence he found to depend on the mass of iron that is interposed, and not on the surface merely. He was led to suspect that a similar effect might be obtained by employing substances not of a ferruginous nature, provided they were interposed in considerable masses, and the result of his trials justified his conjecture. An account is given of several experiments made with large masses of silver, copper, or zinc, of about four inches in thickness, which being interposed between a revolving magnetic plate and a delicately suspended disc of tinned iron, completely intercepted the action of the magnet on the iron.

The author considers this interceptive property to be more or less common to every class of substance; and that in order to render it sensible, it is only necessary to employ the bodies in masses, bearing some direct ratio to their respective magnetic energies. Thus lead, having a weaker magnetic energy than copper, must be employed in a larger mass in order to produce an equal effect; and to render the screening power of ice sensible would require it to be above thirty feet in thickness. If, instead of interposing the screen of iron immediately between the revolving magnet and the suspended disc of copper, the iron be brought very near the under surface of the magnet, a similar neutralizing influence is exerted.

In the second paper, the investigation of this subject is resumed, and the neutralizing power of a mass of iron investigated under different circumstances. From the experiments detailed by the author, he is led to infer that substances highly susceptible of receiving transient magnetism, are the most efficient in their operation as screens; this operation being referrible to their neutralizing power. It is, however, very difficult to render this power sensible in the case of non-ferruginous bodies, unless they be actually placed between the magnet and the substance acted upon, so as to neutralize effectually the actions of those points which are nearest to each other. The attractive force exerted between a magnet and a mass of iron he finds to be always in the direct ratio of this controlling or screening power of the iron, or, in other words, to its neutralizing power in similar circumstances.

The author suggests that a temporary magnetic state may be conceived to be induced in a substance in two ways: either by the immediate action of the magnet upon each individual particle of the given substance, or else by the action of each particle of that substance on the next in succession, producing a propagation of magnetism from the one to the other. It may also, however, take place in both these ways at the same time. But these different modes of action appear to be in some inverse ratio of each other: for when the retentive or absorbing power of the substance is considerable, the power of the magnet becomes soon controlled; because the particles of the substance first acted upon, begin to operate as screens to the succeeding ones, and the induced magnetism after a certain point, proceeds entirely by communication from particle to particle, until the whole power is expended. When, on the contrary, the retentive power of the given substance is small, little or no screening energy exists between its particles, in which case the magnetic excitement will depend upon the influence of the magnet on each individual particle: hence it is only by the succession or multiplication of effect resulting from a great number of particles, that we at length render the controlling power of such a substance sensible. The diminished action of a magnet on a disc of copper, when intersected by radiating grooves, seems to be owing to this cause, since a portion of the substance, requisite to the full development of the magnetic energy, is removed. In confirmation of this reasoning it was found that the number of oscillations of a delicately suspended bar, made in vacuo, in a given arc, surrounded by a mass of copper formed into rings, did not sensibly differ when, in the one case, that mass was made up of concentric rings, and, in the other, was entirely solid: while, on the contrary, by removing a very thin external lamina from the former, the number of vibrations was sensibly changed.

The concluding part of this paper is occupied by speculations on the nature of magnetic action: the author being disposed to regard a magnet as rather in a passive than an active state, when exhibiting the phenomena of magnetic attraction. This attraction he considers as the result of an impression first made on the magnet by the iron which appears to be attracted by it: because he finds that with different masses of iron of the same quality, the force at the same distance is unequal; being with some pieces very sensible, whilst with others it is altogether inappreciable. He views a magnet as a substance put into a peculiar state or condition, in consequence of which it exhibits certain properties when subjected to external excitation; in a way analogous to the elastic force of a spiral spring, which is not called into action unless that spring is stretched by a weight suspended to it, or by some other extraneous force. In the case of magnetism, the exciting substance is likewise affected in a similar manner with the magnet which it excites; and the analogy of the spiral spring may be further pursued, in order to render the two cases corresponding, by supposing the weight which elongates the first spring to be itself another similar spiral spring, which is also elongated while exerting its force on the first. Under these circumstances the separation of the coils will be greatest at the upper end of the whole combination of springs, at least at the lower part, presenting a contrariety of states at the two extremities, analogous to the opposite polarities of the two ends of a magnet.

A paper was read, "On the Atmosphere of Mars." By Sir James South, F.R.S.

The author refers the origin of the hypothesis of the "Extensive Atmosphere of Mars" to the observations of Cassini and Rœner, made at Briare and Paris in the year 1672. By the former it would seem that a star of the fifth magnitude became invisible with a three-feet telescope when at a distance of six minutes from the planet; whilst by the latter the same star, after having undergone occultation by the planet, could not be perceived with a large telescope till Mars had receded from it a distance equal to two thirds of his own diameter; although with the same instrument stars of similar magnitude might be easily distinguished even when in contact with the moon's limb.

As opposed to these observations, the author advances his own. One, dated Blackman-street, February 19, 1822, in which a star of the ninth magnitude as seen with the five-feet equatorial suffered no diminution of its apparent magnitude, at a distance of 103 seconds from the planet. A second, on the night following, when the star 42 Leonis having been seen within a second of a degree of the planet's limb prior to occultation by the planet, was perceived after emersion, when only one second and one tenth from it; the instruments of observation in this instance were the five-feet equatorial and the thirty-inch Gregorian reflector, the former instrument being used by the author, the latter by Mr. Henry South. The third was made at Campden Hill, on the 17th of March of the present year, with an eight-feet achromatic of six inches aperture; and in this the star 37 Tauri was with a power of 320 seen actually touching the planet's limb.—The star in neither instance suffered more diminution of brightness than might fairly be attributed to the diffused light of the planet.

From these observations, and the apparently contradictory ones of Cassini and of Rœner, the author of this paper infers, that the existence of the extensive atmosphere of Mars is a subject highly meriting further investigation.

He then directs attention to the fact that 37 Tauri was of a red colour when in contact with Mars; whilst 42 Leonis was under similar circumstances of a blue colour: and, from inferences dependent upon observation, states, that the apparent anomaly is easily reconcilable, and that an hypothesis is not wanted to account, on the occasion alluded to, either for the red colour of the one star, or the blue colour of the other.

A paper was read "On the Inflexion of Light." By John Barton, Esq. Communicated by Davies Gilbert, Esq. V.P.R.S.

The design of the author in undertaking the experiments of which he gives an account in the present paper, is to carry on the investigation of the phenomena of the inflexion of light from the point at which it was left by Newton. He begins by examining these phenomena in their simplest form, comparing the appearance of the shadow of an opaque body on a screen of white paper at different distances, with the appearance it would exhibit if the rays passed by the edge of the body, without suffering any deviation from a rectilinear course. It is well known that, under these circumstances, the real shadow is broader than the geometrical shadow, indicating a deflexion of the rays from the edge of the intercepting body. By varying the distances at which the observations are taken, it is found that the rays are not bent at a sharp angle, but pursue a curvilinear course, the concavity of which is towards the shadow, the curve itself resembling an hyperbola. A luminous halo also appears beyond the shadow; the breadth of this halo agreeing accurately, at all distances, with the space which the penumbra should occupy, if the rays were not bent. The author thinks it impossible to reconcile the explanation of these phenomena given by Newton, with his own hypothesis concerning the action of solid bodies on light, as stated in the "Principia:" for, in that hypothesis, the rays passing nearest to the edge of an intercepting body are supposed to be bent towards the edge, as if attracted; whereas the explanation proceeds upon the supposition that they are bent from that body, as if repelled. The actual hyperbolic course of the rays is also inconsistent with that hypothesis, which would assign to them a parabolic path. It also appears that the breadth of the spectrum made by receiving the sun's rays through an aperture one tenth of an inch, or more, in width, is less than if the rays proceeded in straight lines; but if the aperture is very much diminished, the result is reversed, the real spectrum being broader than the geometrical spectrum.

The author conceives, that the whole of the observed phenomena will admit of explanation, by assuming that light consists of material particles, endowed with a power of mutual repulsion, in which case they would obey the laws of elastic fluids; and the course of the rays might admit of comparison with the motions of the particles of air, or other similarly constituted fluids, in flowing past an obstacle opposed to their progress. He shows how this hypothesis furnishes an explanation of the deflexion of the rays, and of the curvature of their path; and why that path resembles an hyperbola. He supports this theory by the analogy of the laws of heat, considered as the properties of a material fluid, with those of light; both exhibiting the phenomena of reflexion, refraction, and polarization. The author is inclined to believe that, besides the deflecting force, the presence of which is already established, there exists also an inflecting force, which bends some of the rays towards the intercepting body; and states a variety of considerations in support of this fact. He explains, on the same principles, the phenomena described by Newton under the appellation of *fits of easy reflexion and easy transmission*, which Dr. Young has explained on the undulatory theory, by the principle of interferences; but which may be considered as analogous to the alternating movements of elastic fluids striking against an opposing body, or entering by a narrow aperture; movements which, in air, give rise to vibrations constituting musical sounds.

The Society then adjourned over the Long Vacation, to meet again on the 17th of November.

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